Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] What is claimed is:

1.A variable gain amplifier, comprising:

an amplifying stage for generating an output voltage according to a differential input voltage; and

a gain controlling stage for generating a gain controlling voltage to control a voltage gain of the amplifying stage according to a first controlling voltage and a second controlling voltage, such that the voltage gain is inversely proportional to a simple exponential function, the value of the simple exponential function being determined by the difference between the first controlling voltage and the second controlling voltage, and the voltage gain of the variable gain amplifier is independent of a thermal voltage.

[c2] 2.The variable gain amplifier of claim 1, wherein the denominator of the voltage gain of the amplifying stage can be expressed as $(K1+\exp(K2\times Vy))$, wherein both K1 and K2 are substantially constants and Vy is the gain controlling voltage.

[c3] 3.The variable gain amplifier of claim 1, wherein the gain controlling stage comprises:

a proportional_to_Vt voltage amplifier for generating a third controlling voltage and a fourth controlling voltage according to the first controlling voltage and the second controlling voltage, wherein the difference between the third controlling voltage and the fourth controlling voltage is corresponding to the thermal voltage and the difference between the first controlling voltage and the second controlling voltage;

a first transconductance unit for generating a third current and a fourth current according to the third controlling voltage and the fourth controlling voltage, wherein the ratio between the third current and the fourth current is determined by the difference between the third controlling voltage and the fourth controlling voltage;

a current transforming unit coupled to the first transconductance unit for generating a fifth current corresponding to the third current, and a sixth current corresponding to the fourth current; and

an outputting unit coupled to the current transforming unit for generating the gain controlling voltage according to the fifth current and the sixth current;

wherein the value of the gain controlling voltage is determined by the difference between the first controlling voltage and the second controlling voltage.

[c4] 4.The variable gain amplifier of claim 3, wherein the

proportional_to_Vt voltage amplifier is a differential amplifier, comprising a first half circuit and a second half circuit, the first half circuit comprising:
a second transconductance unit for generating a first current according to the first controlling voltage; and
a transresistance unit, coupled to a reference voltage, for generating the third controlling voltage according to the first current, wherein the difference between the third controlling voltage and the reference voltage is proportional to the thermal voltage.

[c5] 5.The variable gain amplifier of claim 4, wherein the second transconductance unit comprises:
an operational amplifier having a first input end, a second input end, and an output end, wherein the first input end is coupled to the first controlling voltage; and
a first resistor having one end being coupled to the second input end and the output end of the operational amplifier, and the other end being coupled to ground;
wherein the first current flows through the first resistor.

[c6] 6.The variable gain amplifier of claim 4, wherein the first half circuit further comprises:
a first current mirror, coupled to the second transconductance unit, for generating a second current according to the first current.

[c7] 7.The variable gain amplifier of claim 6, wherein the transresistance unit comprises:
a first transistor for receiving the reference voltage;
a second transistor coupled to the first current mirror, wherein the second transistor is for generating the third controlling voltage;
a second current mirror coupled to the first transistor and the second transistor; and
a first bias current source coupled to the first transistor and the second transistor, for providing a first bias current.

[c8] 8.The variable gain amplifier of claim 7, wherein the second current mirror comprises:
a third transistor having a first and a second ends being coupled to the first transistor; and
a fourth transistor having a first end coupled to the second transistor and a second end coupled to the gate of the third transistor.

[c9] 9.The variable gain amplifier of claim 3, wherein the value of the fifth current is substantially the same as that of the third current, and the value of the sixth current is substantially the same as that of the fourth current.

[c10] 10.A proportional_to_Vt voltage amplifier, comprising:
a transconductance unit for generating a first current ac-

cording to a first input voltage; and
a transresistance unit, coupled to a reference voltage, for generating a first output voltage according to the first current, wherein the difference between the first output voltage and the reference voltage is proportional to a thermal voltage.

[c11] 11.The proportional_to_Vt voltage amplifier of claim 10, wherein the transconductance unit comprises:
an operational amplifier having a first input end, a second input end, and an output end, wherein the first input end couples to the first input voltage; and
a first resistor having one end being coupled to the second input end and the output end of the operational amplifier, and the other end being coupled to ground;
wherein the first current flows through the first resistor.

[c12] 12.The proportional_to_Vt voltage amplifier of claim 10 further comprising:
a first current mirror, coupled to the transconductance unit, for generating a second current according to the first current.

[c13] 13.The proportional_to_Vt voltage amplifier of claim 12, wherein the transresistance unit comprises:
a first transistor for receiving the reference voltage;
a second transistor having a first end coupled to the first

current mirror, wherein the second transistor is for generating the first output voltage;

a second current mirror coupled to the first transistor and the second transistor; and

a first bias current source coupled to the first transistor and the second transistor for providing a first bias current.

[c14] 14.The proportional_to_Vt voltage amplifier of claim 13, wherein the second current mirror comprises:

a third transistor having a first and a second ends coupled to the first transistor; and

a fourth transistor having a first end coupled to the second transistor and a second end coupled to the gate of the third transistor.

[c15] 15.The proportional_to_Vt voltage amplifier of claim 10, wherein the proportional_to_Vt voltage amplifier is a half circuit of a differential proportional_to_Vt amplifier.